Trends in Survival and Recovery From Stroke and Compression of Morbidity

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See related article, pages 563–565.

Substantial increases of life expectancy in developed countries are well documented, and further increases are anticipated in the 21st century.1 The question remains, however, whether this increased longevity can be achieved together with postponed functional limitation and disability or whether increasing life expectancy will yield greater disability.1 According to the Compression of Morbidity paradigm, “if the average age at first chronic infirmity is postponed, and if this postponement is greater than increases in life expectancy, then average cumulative lifetime morbidity will decrease, squeezed between a later onset and the time of death.”2

Although the biological foundation of compression of morbidity remains unknown, data from various clinical/epidemiological databases can be helpful in our understanding of short- and long-term trends for major diseases, including disease incidence, survival, and recovery. In developed countries, the number of people greater than age 65 is increasing. When people age, they become more susceptible to disease, and their risk of mortality dramatically increases. However, an explosion of recent advances in disease-modifying factors, including specific prevention strategies, treatments, and rehabilitation options, should lead to decreases in both disease incidence and mortality, resulting in positive trends in life extension and recovery rates.

Worldwide, stroke remains 1 of the major causes of death and long-term disability. Stroke imposes substantial burden, both economic and social, on individuals, their families, and society.3 As with many other diseases, the incidence of stroke increases dramatically with age.4 The impact of stroke, and its challenge to health care systems, is expected to increase during the next decade, as the “baby boomers” enter older age. Fortunately, advances in early diagnosis, treatment, and rehabilitation have given rise to evidence-based stroke prevention and treatment strategies in many countries. It is hoped that the wider adoption of such strategies will result in decreased stroke mortality and morbidity. In addition, a better understanding of the risk factors associated with stroke and resultant changes in lifestyle, including an emphasis on stress management, physical activity, exercise, and diet, may potentially contribute to a decline in stroke incidence rate. However, although age-specific incidence might decline, will the overall rate of stroke also decline, and with that, will we see less stroke-related disability?

In the past 25 years, there has been a considerable decline in stroke-associated mortality in the United States. Such a decline could be attributed to a reduction in the incidence rate, due to the many factors mentioned previously. However, these explanations are not mutually exclusive, and it is worth noting that such distinctions can be made by analyzing existing biomedical and epidemiological data. For example, stroke survival significantly improved between 1984 and 2001 among older US adults, though with an increased rate of dementia in stroke survivors.5

In this issue of Stroke, Yashin et al suggest a way of collecting information about trends in survival separately from stroke recovery by using data from the National Long-Term Care Survey (NLTCS) and merging these data with data from the national Medicare database. The authors suggest an indicator characterizing stroke recovery and evaluate its changes over time. They propose a working definition of the “recovery rate” based on analysis of Medicare records as being “survival free of stroke recurrence” or, as they called it, “recovery or sustained remission.” Time to recovery was defined as the period of time after the last inpatient or outpatient visit related to the stroke according to ICD codes. These definitions allowed the authors to report “survival and not-yet recovery,” to apply Kaplan-Meier estimators, to plot and analyze “not-yet-recovery” curves, and also to calculate corresponding statistics. Although the survival curves corresponding to better survival are situated above those corresponding to worse survival, the lower “not-yet-recovery” curves indicate better recovery; median survival times can be derived from these estimators.

The authors compared 2 cohorts of people with a stroke diagnosis between 1994 to 1996 and 1999 to 2001. Five-year follow-up was reported for both groups. Although the authors did not find significant differences in mortality, they did find that the “recovery time from stroke” was significantly decreased during the period between 1994 and 1999. Most important, the authors found that recovery improvement was significant in each age group and in each comorbidity and disability stratum. By contrast, no significant changes in mortality rates were found (authors’ Figure 1, right panels).

The results of the analysis stratified by sex, age, comorbidity, and disability levels can be seen as a validation of their approach, as the results are readily interpreted. The improvement in recovery rate was significant in women but not in...
men (although women are reported to be more severely ill and sex differences can be explained by confounding). Of note, the median recovery time was consistently lower in the later cohort in men. It may be that the observations regarding men did not reach statistical significance because of the smaller number of men included in the samples. Age differences in trends in recovery rate are also of interest, with younger people having a lower value of median recovery in the later cohort that was not seen in the older group (age 85+). A similar picture was seen with comorbidities and disabilities: the groups with the highest level of comorbidities (Charlson index >3) and disabilities (=3) did not show any trends in recovery, whereas those with fewer comorbidities and less disability clearly showed positive trends in recovery.

All of these analyses share 1 thing in common: more benefits are seen in the groups with the least amount of vulnerability. Because vulnerability is synonymous with frailty, it is not unreasonable to use frailty status when identifying such groups; the application of a frailty index may have potential for stratifying patients into different groups by their vulnerability status.

One limitation of the study is that it is unclear whether or not the authors were looking at patients with a diagnosis of “first-ever stroke” or any stroke. This is important, because a leading risk factor for stroke is a previous stroke, and persons with previous strokes are often more vulnerable and more frail than those with a first-ever stroke. The authors also do not say much about how recent improvements in the evaluation and early management of transient ischemic attack and nondisabling stroke may relate to overall improvements in care, as reflected in potentially decreased rates of recurrent stroke (and subsequent hospitalization).

As noted, the authors define “recovery time” as an interval during which patients were not readmitted to hospital with an ICD-9 diagnosis of stroke. Obviously, this definition of “recovery time” is somewhat different from what clinicians understand by “recovery,” ie, as a state of not being disabled, or more realistically, being less disabled than they were at the onset of their stroke. Patients and families are mostly interested in how disabled they or a loved one will be after stroke (if they survive). More information about the disability status of those who survived (according to standardized methods and with stratification by whether care was provided on a stroke unit or not) could have been a helpful addition to the analyses.

With respect to the inpatient care of stroke patients, the results of this study may not be a surprise to front-line workers, as it has been proven that organized, interdisciplinary care on a geographically defined stroke unit results in increased survival and reduced short- and longer-term disability. This is in fact the current accepted standard for inpatient stroke care. The present study may be another in a long line of comparative studies that support this concept.

The replication of the results of this study in different datasets and particularly with extension to larger periods between the cohorts would be of great interest and allow a fuller understanding of trends in recovery. The addition of information regarding the process of care may help us to understand some of the many potential factors associated with these trends. It also seems that positive trends in recovery may support the compression of morbidity hypothesis, especially if the lesser recovery seen in groups with greatest vulnerability would be associated with high mortality.

**Disclosures**

None.

**References**


**Key Words:** survival ■ recovery ■ frailty ■ frailty index
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